DETAILED ACTION: claim rejections under 35 USC 112

Claims 5 and 8 stand rejected under 35 USC 112 second paragraph. More specifically, claim 5 depends from canceled claim 4 and claim 8 recites "said elastomeric copolymer" without antecedent basis.

These informalities are hereby corrected by amendment to claims 5 and 8. No new matter or new issue is introduced.

DETAILED ACTION: claim rejections under 35 USC 103

Claims 1-3, 5-9, 11-12, and 35 stand rejected under 35 USC 103(a) as unpatentable over US 6,264,857, hereinafter Kreuer, in view of US 5,219,679, hereinafter Abraham, in further view of EP 337,626, hereinafter Peer. For the record, it appears from the Office Action that Examiner's position is that the combination of Kreuer with Abraham and/or with Peer renders the indicated claims unpatentable for obviousness. The response will be structured accordingly.

With respect to independent claims 1, 11, and 35, Applicant respectfully traverses this claim rejection, on the grounds that it is not obvious to combine the separate elements taught in the several references to arrive at the claimed invention. More specifically, it will be argued:

1) the claims are not rendered obvious by Kreuer in view of Abraham because there is no motivation to modify Kreuer in view of Abraham to arrive at the present claims;

2) the claims are not rendered obvious by Kreuer in view of Peer because there is not a reasonable expectation of success in

modifying Kreuer in view of Peer to arrive at the present claims; and

3) consideration of the combination of Kreuer with both Abraham and Peer does not raise any issues other than the ones considered in arguments 1 and 2.

Argument 1:

Claims 1, 11 and 35 of the present application recite a polymer membrane comprising a first polymer having acidic subunits, a second polymer having basic subunits, and an elastomeric polymer having elastomeric subunits. Examiner has held 1) that Kreuer teaches a polymer membrane comprising a first polymer having acidic subunits and a second polymer having basic subunits; 2) that the membrane of Kreuer is directed toward similar applications as the present invention (e.g., fuel cell applications); and 3) that Kreuer does not teach the addition of an elastomeric polymer to a polymer including a first polymer having acidic subunits, and a second polymer having basic subunits.

Examiner has held that Abraham teaches the use of polyacrylonitrile (PAN) (i.e., an elastomer) in a polymer electrolyte membrane to improve ionic conductivity, which is well known to be an important parameter for fuel cell performance. Applicant respectfully disagrees with this finding relating to Abraham. More specifically, Abraham teaches the use of an appropriate solvent (e.g., a mixture of ethylene carbonate (EC) and propylene carbonate (PC)) in a polymer electrolyte membrane to improve ionic conductivity (line 62 of column 3 to line 12 of column 4). Abraham also includes a polymer matrix for immobilizing or encapsulating the combination of solvent and

salt. The matrix of Abraham can be an elastomer (e.g., PAN). However, the matrix of Abraham is not regarded as playing a critical role in his invention, and in particular is not identified as being related to ionic conductivity. In fact, lines 13-18 of column 5 read: "The nature of the polymer suitable for use as a matrix for immobilizing or encapsulating the ionically conductive Li salt solvate phase is of less importance. This is evident in the data in Figs. 1 and 2 and Table 1. Polymers suitable for this purpose include polyacrylonitrile, (PAN), ..."

Thus Abraham teaches an elastomer (e.g., PAN) as a mere matrix or background material, and does not teach that use of PAN improves ionic conductivity. Therefore, Applicant contends that an art worker reading Abraham would not be motivated to add PAN (or another elastomer) to the polymer electrolyte membrane of Kreuer in order to improve ionic conductivity (as Examiner has held). Instead, the teachings of Abraham would lead an art worker to introduce solvents (e.g., a mixture of EC and PC) into the membrane of Kreuer to improve ionic conductivity. Absent a clear motivation (e.g., improving ionic conductivity), it would not be obvious to an art worker to modify Kreuer by adding an elastomeric polymer in view of Abraham. In general terms, the mere fact that someone (e.g., Abraham) teaches that an elastomer can be included in a polymer membrane does not suffice to render any and all instances of a elastomer in a polymer membrane obvious.

Argument 2:

Examiner has held that Peer teaches a polymer membrane having a first polymer having acidic subunits (e.g., sulphonated

polyetherether ketone (SPEEK)) and a elastomeric polymer having elastomeric subunits (e.g., PAN). Furthermore, Peer teaches that such membranes are hydrophilic, even through their constituents are relatively hydrophobic. Finally, it is noted that although Peer is directed to membranes for reverse osmosis and filtration, hydrophilic membranes are typically preferred in fuel cell application to enhance proton conductivity.

The central idea of Peer is that the specific compositions he teaches (e.g., SPEEK and certain other polymers including PAN) are relatively hydrophilic despite having hydrophobic constituents. This is in contrast to the general expectation that membranes having hydrophobic constituents would also be hydrophobic (lines 9-16 of page 2).

Examiner has held that it would be obvious to modify Kreuer in view of Peer to arrive at the claimed invention. Applicant respectfully disagrees, since the teaching of Peer does not establish a reasonable expectation of success in such modification. In particular, an art worker reading Peer is not given a reason to believe that the unusual feature of Peer (hydrophilic film from hydrophobic components) can be realized in the membrane of Kreuer by the addition of an elastomer (e.g., PAN) to the membrane of Kreuer. In other words, Peer teaches the following: 1) membranes having hydrophobic constituents are usually hydrophobic; and 2) the particular compositions identified in Peer are exceptions to this general tendency. The membrane of Kreuer is not one of the compositions identified by Peer, and addition of PAN to the membrane of Kreuer would not make it one of the compositions taught by Peer (since Peer does not consider the combination of an acidic polymer, a basic

polymer and an elastomeric polymer). Therefore, Applicant contends that an art worker considering Kreuer in view of Peer would be more likely to expect the typical behavior of point #1 (i.e., a hydrophobic membrane) as opposed to the unusual behavior of point #2 (i.e., a hydrophilic membrane), thereby rendering the modification of Kreuer required to reach the present claims non-obvious.

Argument 3:

Consideration of Kreuer in view of Abraham and Peer together does not raise any issues not already considered above, because Abraham and Peer relate to separate and distinct applications of elastomers (e.g., PAN) in polymer membranes. In Abraham, PAN is used as a matrix material to immobilize and/or encapsulate the conducting salt/solvent mixture. In Peer, the combination of PAN with SPEEK is found to unexpectedly provide a hydrophilic membrane having hydrophobic constituents. In more general terms, Abraham and Peer can be regarded as two examples of cases where PAN has been found to be a useful constituent in a polymer membrane. Mere multiplication of such examples does not suffice to make modification of Kreuer to arrive at the claimed invention obvious.

For these reasons, Applicant respectfully traverses this rejection of independent claims 1, 11, and 35.

Claims 2-3 and 5-9 depend from claim 1, and claim 12 depends from claim 11. Therefore the above arguments in connection with claims 1 and 11 are also responsive to this rejection of claims 2-3 and 5-9.

DETAILED ACTION: allowable subject matter

Claim 10 stands as allowable.

Applicant appreciates the indication of allowable subject matter.

REMARKS

The above amendments and arguments are responsive to the claim rejections made in this Office Action. Accordingly, Examiner's reconsideration of, and allowance of, this application is respectfully requested.

Respectfully submitted,

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